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Short Communication

Phosphate Availability and Importance in a Living System

Oves M[1,2]* and Iqbal IMI[1,3]

[1]*Center of Excellence in Environmental Studies, King Abdulaziz University, Jeddah, Saudi Arabia*

[2]*Department of Biological Sciences, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia*

[3]*Department of Chemistry, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia*

***Corresponding Author:** Oves M, Department of Biological Sciences, Center of Excellence in Environmental Studies, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia

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Phosphorus (P) has a vital role in biological systems, in the form of phosphate is highly required because its presence may control the growth rate of organisms. It is an essential element for the stability of DNA and RNA in all living things and maintains the memory unit of an organism. The empirical phosphate formula is PO^{3-}_4 showing polyatomic ion with 94.97 g/mol molar mass. It consists of an in a tetrahedral arrangement of central one phosphorus atom surrounded by four oxygen atoms. The phosphorus is found in the form of phosphate ion (PO^{3-}_4), it is an inorganic form, and it is derivative of phosphoric acid, while phosphate is an ester of phosphoric acid as an organic form. At elevated temperature, phosphate becomes condense and formed pyrophosphate, which makes it water-soluble. However, at standard temperature and pressure, most of the phosphates are slightly or not soluble in the aqueous system. Some water-soluble phosphate- cesium, potassium, rubidium, sodium, and ammonium phosphates. When phosphate with hydrogen and dihydrogen then it is slightly more soluble than the other phosphates. In aqueous system P exists in four forms: (i) PO^{3-}_4 (Phosphate ion), it is predominates in actively basic environments, (ii) HPO^{2-}_4 (Hydrogen phosphate ion) is weakly basic, (iii) $H_2PO^-_4$ (Dihydrogen phosphate ion) found in weakly acidic surroundings, (iv) H_3PO_4 (Trihydrogen phosphate) is the most common in strongly acidic situations. The pyrophosphate becomes hydrolysis in the presence of moisture and generates two molecules of inorganic hydrogen phosphate, denoted as PPi: $P_2O^{4-}_7 + H_2O \rightleftharpoons 2\ HPO^{2-}_4$

The organic phosphates have an essential role in cell metabolism, biogeochemistry, biochemistry, the integrity of the biological system, and consequently in ecology and sustainability of the ecosystem. Biologically, phosphate role in the regulation of metabolic pathways and energy store and released by the reversible protein reaction of phosphorylation and dephosphorylation in the living system [1]. However, in the living bio-system, P is present as a free phosphate ion and bound to the phosphate esters at physiological pH and as an HPO^{2-}_4 and $H_2PO^-_4$ ions [2]. In general, in living system phosphates are found in the form of adenosine phosphates (mono, di, and tri as AMP, ADP, and ATP respectively) and takes part in energy storage, and release and also take part in the synthesis and stability of DNA and RNA to maintain the cell shape and genetic memory. Phosphate ions and energy released when hydrolysis of ATP or ADP occurred in the cells of living organisms [2]. Phosphate is also valuable in animal cells as a buffering agent.

Phosphorus is a crucial essential nutrient of the plant because it takes part in catalysis of metabolic reaction, capturing sunlight and store energy and structural and genetic element development.

Some specific plant growth factors that linked with the phosphate availability- (i) root development stimulation (ii) stalk and stem strength enhancement (iii) flowering and seed production enhancement (iv) uniform and crop maturity (v) nitrogen N-fixing capacity enhancement in legumes (vi) provide disease resistance in crop and improve the crop quality [3].

Interestingly, the diagnosis of phosphate deficiency in the plant is more difficult in comparison to the scarcity of another critical

nutrient like nitrogen or potassium. Because phosphate is a highly mobile state in the plant, it trans-located old plant tissue to actively growing young tissue. During deficiency of phosphate crop symptoms is not detected but in some case show stunting in early growth and abnormal discoloration of leaves [4].

The improvement in the phosphate availability in the soil is a critical task for planters because they introduce phosphate in the soil by the amendments of rock phosphate, bone meal, and manure and phosphate fertilizers but sometimes these amendments in the soil not worked because of nature of the soil [5]. The uptake of phosphate by the plant is limited due to its available forms in soil. In general, a massive amount of phosphorus present in the soil in the form of a complex compound which is not absorbable by the plants [6]. For the acceleration of usable phosphate for the plant in the soil can be optimized by the maintenance of soil pH and amendment of phosphate solubilizing bio-inoculants [7].

To evade the phosphate deficiency in the soil for the plant, in the form of bio-inoculant P-solubilizing microorganisms might play an essential role in making available phosphate for plants by the solubilizing of insoluble P-complex [8,9]. The phosphate solubilization by the microbial communities' in vitro condition is well explored while in situ conditions still variable. Some bacteria and fungi are having traits for phosphate solubilization and plant growth promotion when associated with the plant roots [10-12]. The venture is how to make use of such biotic assets to preserve soil fitness while growing the crop productiveness by imparting P to plants.

Now the researcher is focusing on the mechanisms of phosphate solubilization, stable bio inoculants development, and optimization of plant growth promotion by phosphate-solubilizing microorganisms. In the current situation the researcher should be more focus on the mechanisms of phosphate solubilization in adverse condition, and approach of bio inoculants utility for plant growth enhancement by using phosphate-solubilizing microorganisms for crop productiveness under a considerable choice of agro-ecosystems.

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